

1 What is claimed is:

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3 1. A method for constructing a model useful for predicting performance of a system that
4 includes a plurality of interconnected components defining at least one data flow path, the
5 method comprising:

6 referencing a workload specification for the system; and

7 modeling the system using one or more component models, each component
8 model representing selected one or more of the components, each component model
9 arranged in like relationship to the data flow path as the selected one or more of the
10 components represented by the component model, wherein each component model
11 comprises (a) a constraint upon the workload specification input to that component model
12 or (b) a transformer of the workload specification input to that component model so as to
13 result in one or more output workloads that are input workload specifications to
14 subsequent component models along the data flow path or (c) both a constraint and a
15 transformer, and wherein at least one of the component models comprises a constraint.

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17 2. The method of claim 1 wherein the system is a disk array storage system.

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19 3. The method of claim 2 wherein the selected one or more components are selected from
20 the group consisting of interconnects, interfaces, controllers, caches, buses and disk
21 drives.

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23 4. The method of claim 1 wherein one of the component models is a composite of a
24 plurality of constituent component models.

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26 5. The method of claim 1 further comprising:

27 storing a component model so as to enable later retrieval when constructing a
28 model for another system.

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1 **6.** The method of claim 1 further comprising:

2 retrieving a component model originally used in a model of another system,
3 wherein one of the component models is identical to or derived from the retrieved
4 component model.

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6 **7.** The method of claim 2 further comprising:

7 specifying the workload specification in terms of data flow parameters selected
8 from the group consisting of I/O request type, request rate, request size, spatial correlation
9 of requests, temporal correlation of requests, concurrency of requests and correlation
10 among multiple I/O streams.

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12 **8.** The method of claim 7 wherein the specifying step further comprises specifying
13 statistics for the selected data flow parameters.

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15 **9.** The method of claim 1 further comprising:

16 calibrating the model; and
17 validating the model.

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19 **10.** A method for predicting performance of a system that includes a plurality of
20 interconnected components defining at least one data flow path, the method comprising:

21 specifying a workload specification for the system;

22 modeling the system using one or more component models, each component
23 model representing selected one or more of the components, each component model
24 arranged in like relationship to the data flow path as the selected one or more of the
25 components represented by the component model, wherein each component model is (a) a
26 constraint upon the workload specification input to that component model or (b) a
27 transformer of the workload specification input to that component model so as to result in
28 one or more output workload specifications that are input workload specifications to
29 subsequent component models along the data flow path or (c) both a constraint and a
30 transformer, and wherein at least one of the component models is a constraint; and

31 operating on the workload specification by at least some of the component models
32 along the data flow path.

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2 **11.** The method of claim 10 wherein the operating step comprises:

3 arranging the component models in a hierarchy corresponding to the data flow

4 path;

5 using the specified workload as input to the topmost component model in the

6 hierarchy; and

7 applying one or more of the component models to its input workload specification,

8 starting with the topmost component model and then component models at progressively

9 lower levels in the hierarchy, wherein output workload specification at one level is input

10 workload specification at the next lower level, wherein the applying step at each

11 component model comprises:

12 if the component model comprises a constraint, evaluating whether the

13 input workload specification satisfies or violates the constraint;

14 if the component model comprises a workload specification transform,

15 modifying the input workload specification so as to produce one or more output

16 workload specifications that are input workload specifications for component

17 models at the next lower level in the hierarchy; and

18 if the component model does not comprise a workload specification

19 transform, then setting the output workload specification equal to the input

20 workload specification.

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22 **12.** The method of claim 11 further comprising:

23 terminating the operating step the first time a constraint is violated.

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25 **13.** The method of claim 11 wherein the evaluating step further comprises determining

26 quantitatively the extent to which the input workload satisfies or violates the constraint.

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28 **14.** The method of claim 11 further comprising:

29 reporting results of the computationally applying step.

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1 **15.** The method of claim 14 wherein the results comprise a binary indicator, one value
2 corresponding to the case in which all constraints are satisfied, the other value
3 corresponding to the case in which one or more constraints are not satisfied.

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5 **16.** The method of claim 14 wherein the results comprise the identifications of any model
6 components having a constraint that is violated.

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8 **17.** The method of claim 14 wherein the results comprise quantified assessments of the
9 extent to which constraints are satisfied or violated.

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11 **18.** The method of claim 11, further comprising:
12 recursively repeating the specifying step and the applying step until a
13 predetermined condition occurs.

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15 **19.** A computer readable medium on which is embodied content for use in predicting
16 performance of a system that includes a plurality of interconnected components defining
17 at least one data flow path, the content comprising:
18 data specifying a workload for the system;
19 data modeling the system using one or more component models, each component
20 model representing selected one or more of the components, each component model
21 arranged in like relationship to the data flow path as the selected one or more of the
22 components represented by the component model, wherein each component model is (a) a
23 constraint upon the workload specification input to that component model or (b) a
24 transformer of the workload specification input to that component model so as to result in
25 one or more output workload specifications that are input workload specifications to
26 subsequent component models along the data flow path or (c) both a constraint and a
27 transformer, and wherein at least one of the component models is a constraint; and
28 instructions for operating on the workload specification by at least some of the
29 component models along the data flow path.

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1 **20.** The computer readable medium of claim 19 wherein the content further comprises:
2 a database containing data related to component models other than or in addition
3 to said component models.